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RESEARCH MEMORANDUM

MEASURED CHARACTERISTICS OF THE DOUGLAS D-558-1 AIRPLANE (BUAERO NO. 37971) IN TWO LANDINGS

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SUMMARY

Records were obtained of two landings of the Douglas D-558-1 airplane made during the stability and control investigation.

These two records show that the maximum normal-force coefficient used during the landings, 0.95, was considerably below the maximum, 1.2, estimated to be available. The approaches were made at 150 percent of the possible minimum speed, and the actual contacts were at about 115 percent of minimum speed. The rate of descent in the approach was 1200 to 1800 feet per minute at the start of the landing flare.

INTRODUCTION

The NACA is engaged in a flight-research program in the transonic speed range utilizing the Douglas D-558-1 type airplanes which the Navy procured for the NACA. The data obtained have been presented in references 1 to 4.

The present design tendency toward highly loaded airplanes having wings of low aspect ratio or with sweep results in low lift-drag ratios and high sinking speeds in the landing approach. It was felt, therefore, that it might be of general interest to present records of landings of the D-558-1 airplane.

The present paper gives time histories of two landings made in the course of the stability and control investigation. These landings were made by the same test pilot. These data are preliminary results of a complete investigation of the landings of high-speed research airplanes.

SYMBOLS

n normal acceleration, g units

C_{N_A} airplane normal-force coefficient $\left(\frac{nW}{qS}\right)$

V_i indicated airspeed, miles per hour

H pressure altitude, feet

W airplane weight, pounds

S wing area, square feet

q dynamic pressure, pounds per square foot

δ_f flap deflection, degrees

AIRPLANE AND INSTRUMENTATION

A complete description of the Douglas D-558-1 airplane is given in reference 1 and a three-view drawing is presented as figure 1.

The airplane was instrumented to record elevator, aileron, rudder, and stablizer positions, elevator and aileron wheel forces, pedal forces, altitude, airspeed, and three components of acceleration on standard NACA recording instruments.

RESULTS AND DISCUSSION

Time histories of the landings are shown in figure 2. The elevator, rudder, and stabilizer position record is missing for the first landing.

The time history of figure 2(a) shows that an approach speed of approximately 200 to 210 miles per hour was maintained until an altitude of about 140 feet above the ground was reached when a landing flare was initiated; that is, the airspeed was decreased and the angle of attack was increased to landing attitude. Ground contact was made at approximately 170 miles per hour which corresponds to an airplane normal-force coefficient of 0.95. The rate of descent just prior to the start of the landing flare was 1800 feet per minute. The time history of the second landing, presented in figure 2(b), indicates that approximately the same landing technique was used. Approach and contact speeds of approximately 210 and 160 miles per hour were used and the flare was started at about 80 feet from the ground. The rate of descent at the start of the flare was 1200 feet per minute. About 35-percent power was used during the approaches. Had the approaches been made with power off, the rates of descent would have been correspondingly greater.

No data of maximum lift coefficient for gear and flaps down were obtained. However, clean stalls at altitude (reference 3) indicate a $C_{L_{max}}$ of 1.0 in the clean condition at low altitude. It is estimated

that flaps and gear would provide an increment of about 0.2 in normal-force coefficient for a maximum normal-force coefficient of 1.2 in the landing condition. This would correspond to a landing speed of 140 miles per hour. Based on this minimum speed, approach and contact speeds of approximately 150 percent and 115 percent of minimum speed, respectively, were used in these landings.

CONCLUSIONS

From data obtained during approach to landing and landing of the D-558-1 airplane made by one pilot during two landings, it is found that:

1. The maximum normal-force coefficient, 0.95, used in the landings was considerably lower than the maximum, 1.2, estimated to be available, and corresponded to a landing speed of 115 percent of the possible minimum speed.

2. Approach speeds that were approximately 150 percent of the possible minimum speed were used with rates of descent of about 1200 to 1800 feet per minute at the start of the landing flare.

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REFERENCES

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2. Williams, Walter C.: Flight Measurement of the Stability Characteristics of the Douglas D-558-1 Airplane (BuAero No. 37971) in Sideslips. NACA RM L8E14a, 1948.

3. Barlow, William H., and Lilly, Howard C.: Stability Results Obtained with Douglas D-558-1 Airplane (BuAero No. 37971) in Flight up to a Mach Number of 0.89. NACA RM L8K03, 1948.

4. Drake, Hubert M.: Measurement of Dynamic Lateral Stability of the Douglas D-558-1 Airplane (BuAero. No. 37971) in Rudder Kicks at a Mach Number of 0.72. NACA RM L9D06a, 1949.

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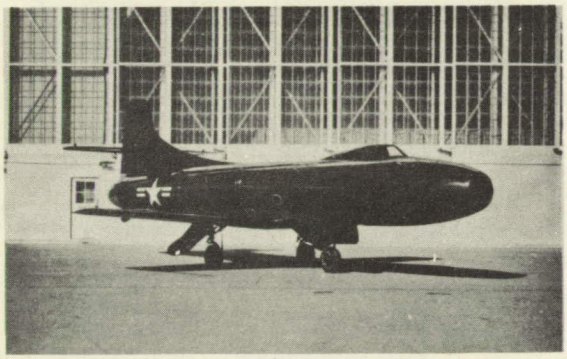
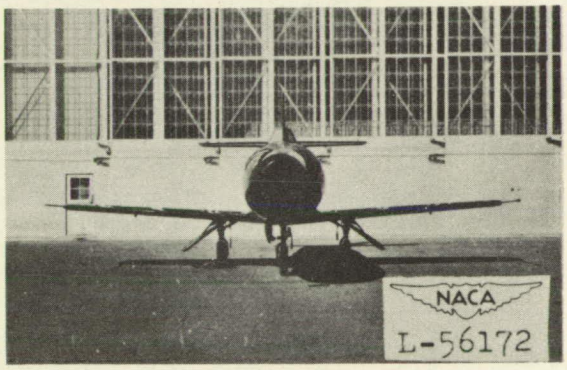
(a) Side view.



(b) Three-quarter front view.



(c) Front view.

Figure 1.- Photographs of D-558-1 airplane.

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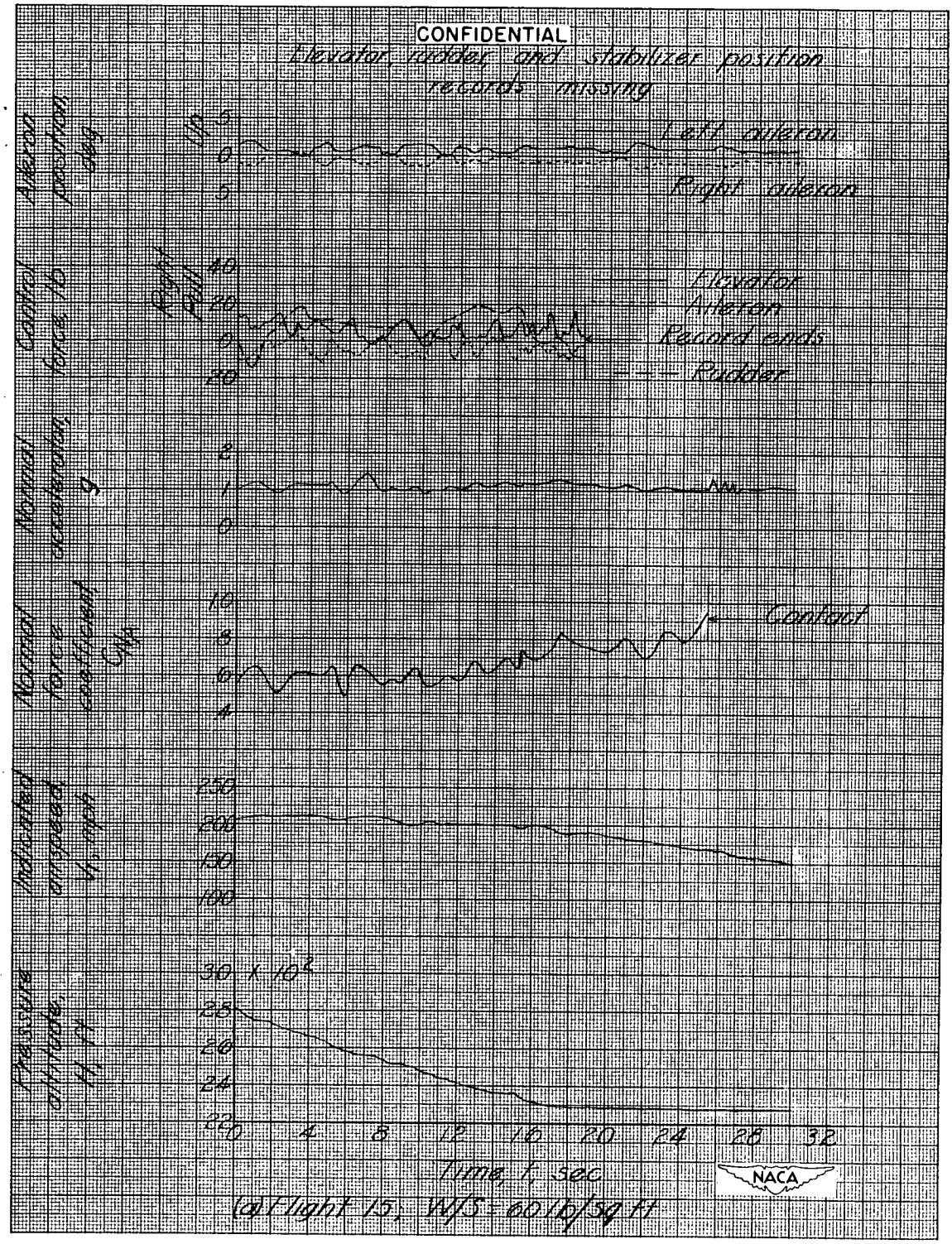

Figure 2.- Time histories of measured quantities in landings of D-558-1 airplane; dive brakes closed; $\delta_f = 50°$.

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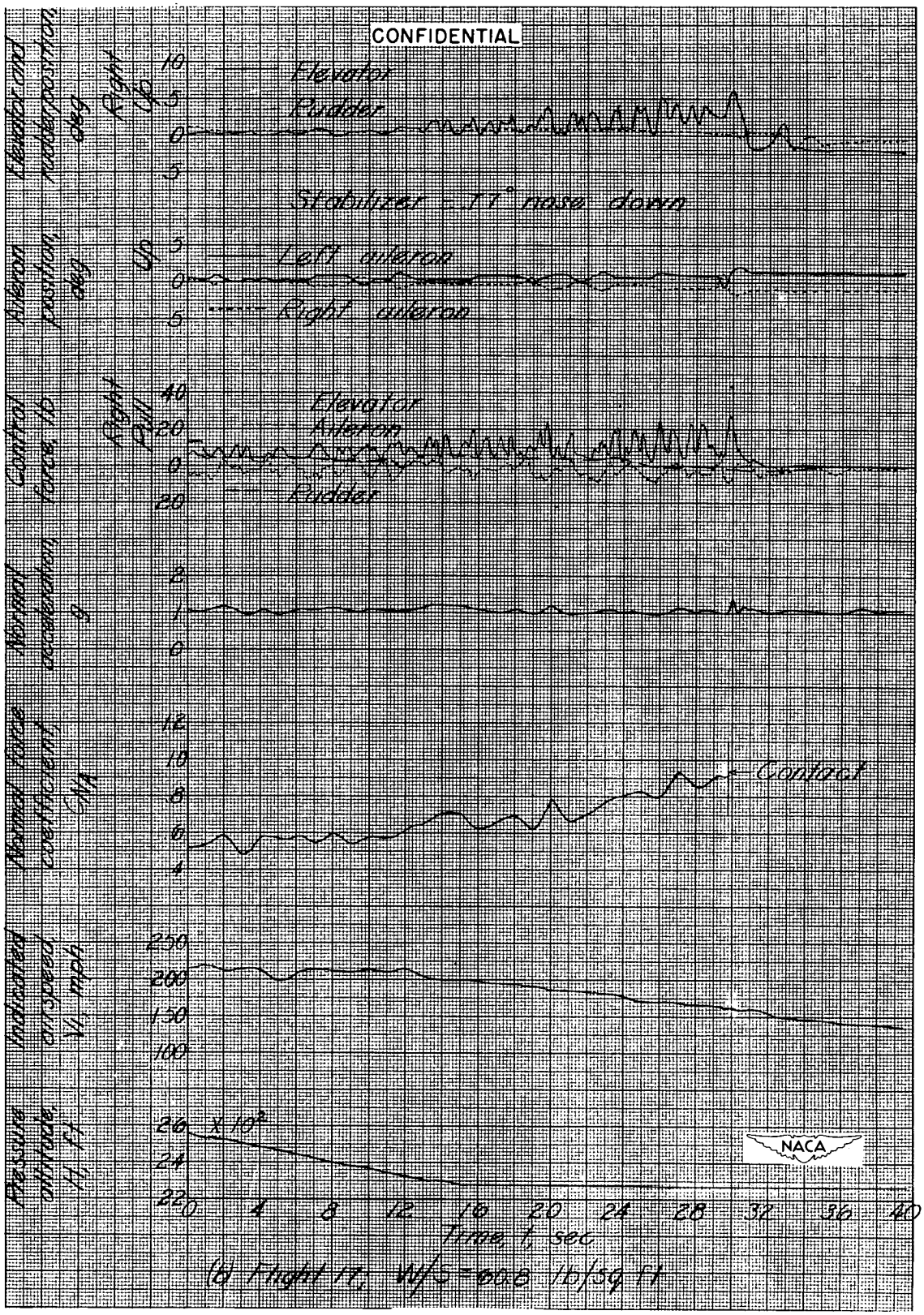

Figure 2.– Concluded.

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